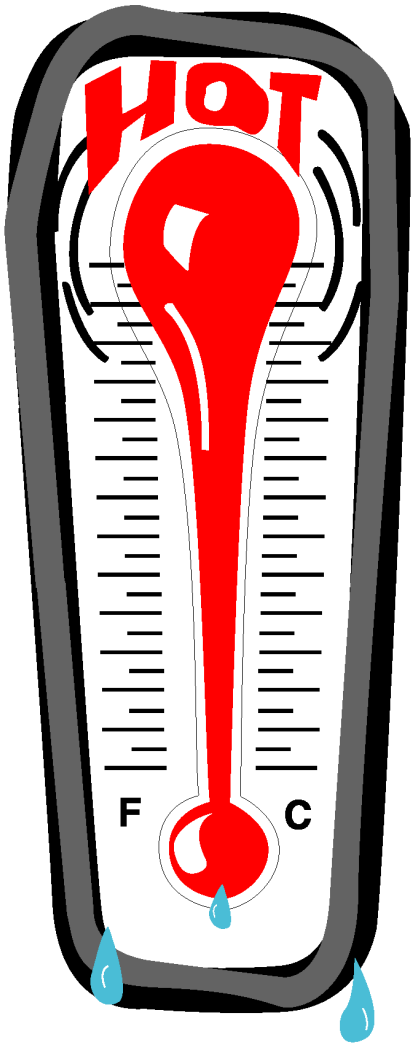
CHILLING CONSIDERATIONS ABOUT GLOBAL WARMING



Stephen E. Schwartz

BROOKHAVEN
NATIONAL LABORATORY

Ethical Culture Society of Suffolk

AEU

April 2, 2006

http://www.ecd.bnl.gov/steve/schwartz.html

TIME MAGAZINE, APRIL 3, 2006

TIME MAGAZINE, APRIL 3, 2006

www.time.com

CANADA

www.time.com

INDIA

www.time.com

INDIA

www.time.com

NEW ORLEANS

www.time.com

ALASKA

www.time.com

UPSALA GLACIER, ANDES, ARGENTINA

1928

2004

www.time.com

RETREAT OF MID-LATITUDE GLACIERS

South Cascade Glacier, Washington

1928

2000

http://ak.water.usgs.gov/glaciology/south_cascade/1928-2000comparison.htm

PASTERZE GLACIER, AUSTRIA 1875 - 2004

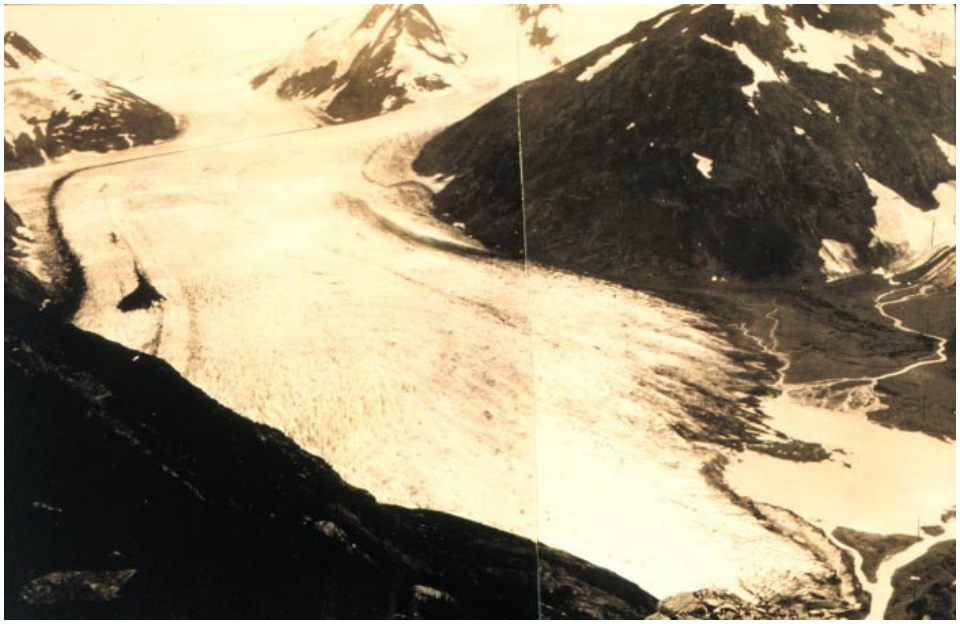
About 2 km shorter.
Terminus replaced by artificial lake.
Decrease in length about 15 meters per year.
In 2003, decrease was 30 m in length and 6.5 m in thickness.

http://www.worldviewofglobalwarming.org/pages/glaciers.html

MOUNT HOOD, OREGON 1984 - 2002

http://www.worldviewofglobalwarming.org/pages/glaciers.html

PORTAGE GLACIER, ALASKA 1914 - 2004



http://www.worldviewofglobalwarming.org/pages/glaciers.html

RHONE GLACIER, VALAIS, SWITZERLAND
1859 - 2001

Glacial retreat is 2.5 km.

Base is 450 meters higher.

http://www.worldviewofglobalwarming.org/pages/glaciers.html

GRINNELL GLACIER
GLACIER NATIONAL PARK 1911 - 2000

http://www.worldviewofglobalwarming.org/pages/glaciers.html

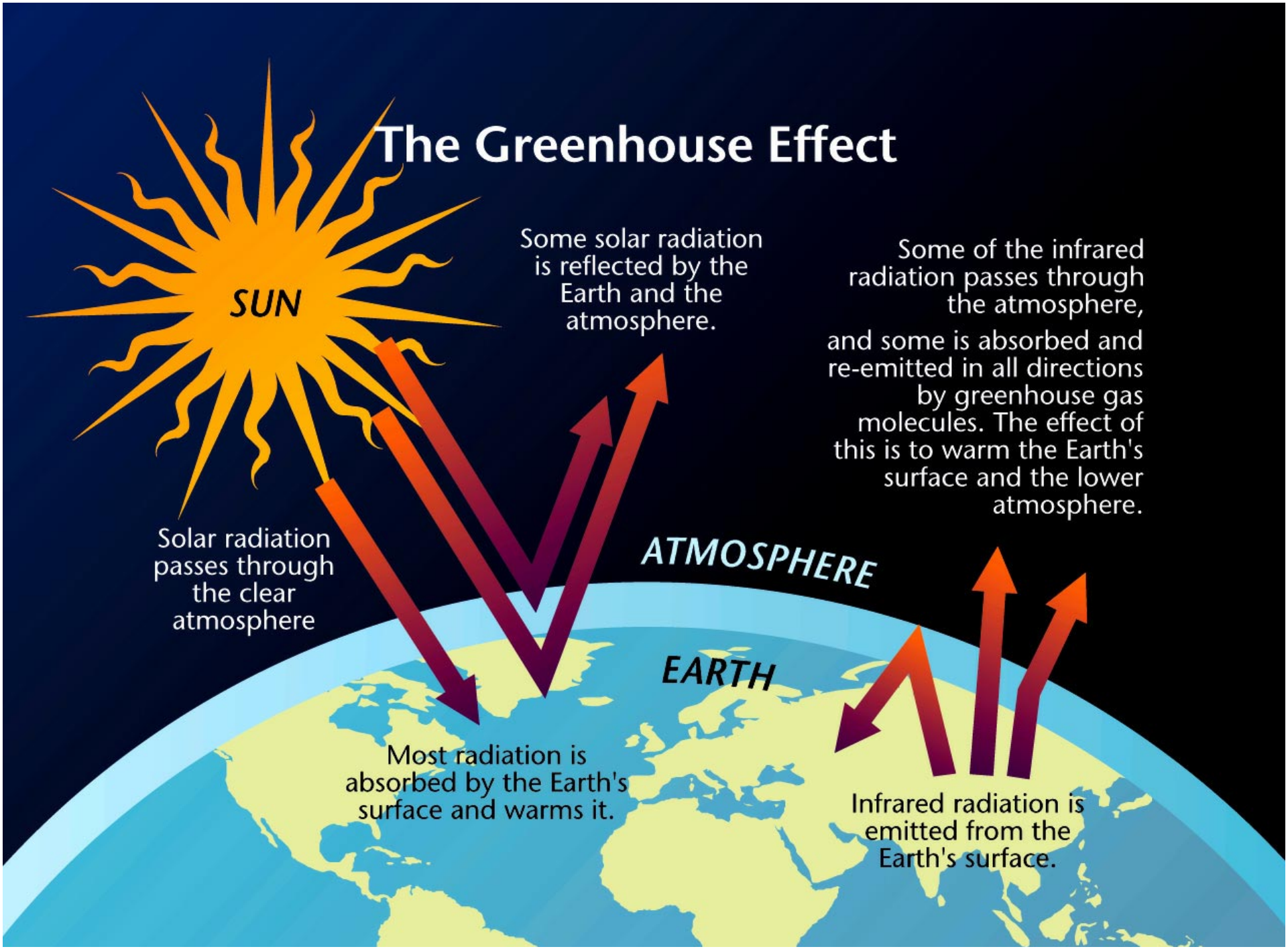
FUNAFUTI, TUVALU

The 11,000 Tuvaluans live on nine coral atolls totaling 10 square miles scattered over 500,000 square miles of the South Pacific.

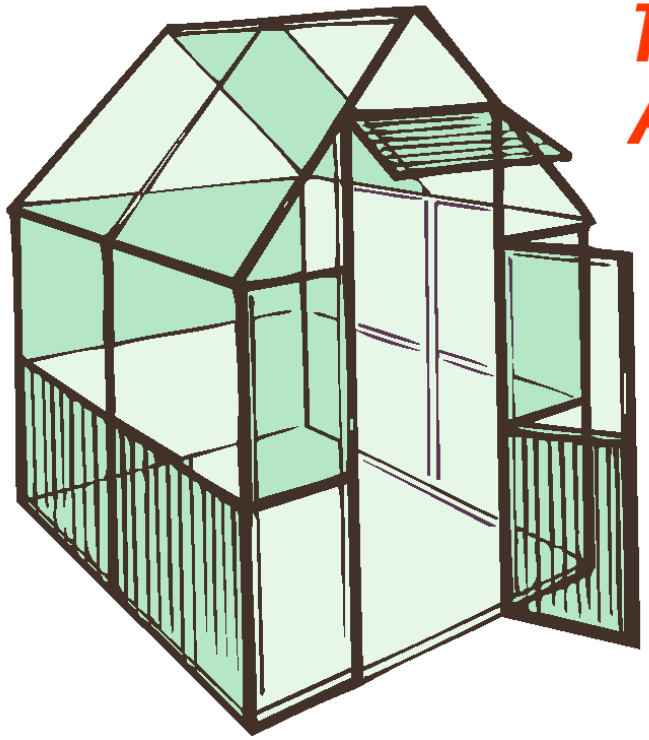
“Our whole culture will have to be transplanted.”

- Paani Laupepa, Former Assistant Environmental Minister
later Assistant Secretary for Foreign Affairs

http://www.worldviewofglobalwarming.org/pages/rising-seas.html


The Greenhouse Effect
SUN
Some solar radiation is reflected by the Earth and the atmosphere.
Some of the infrared radiation passes through the atmosphere,
and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Solar radiation passes through the clear atmosphere
ATMOSPHERE
EARTH
Most radiation is absorbed by the Earth's surface and warms it.
Infrared radiation is emitted from the Earth's surface.

THE GREENHOUSE EFFECT



THE EARTH'S ENERGY BUDGET: A DELICATE BALANCE

- Sunlight heats the Earth.
- The warm Earth radiates energy (in the form of infrared radiation, or heat) back out to space.
- Some of this infrared radiation is trapped in the atmosphere, giving Earth its temperate climate.

This is the greenhouse effect. Without it, the Earth's climate would be like the moon's, harsh and severe.

ATMOSPHERIC RADIATION

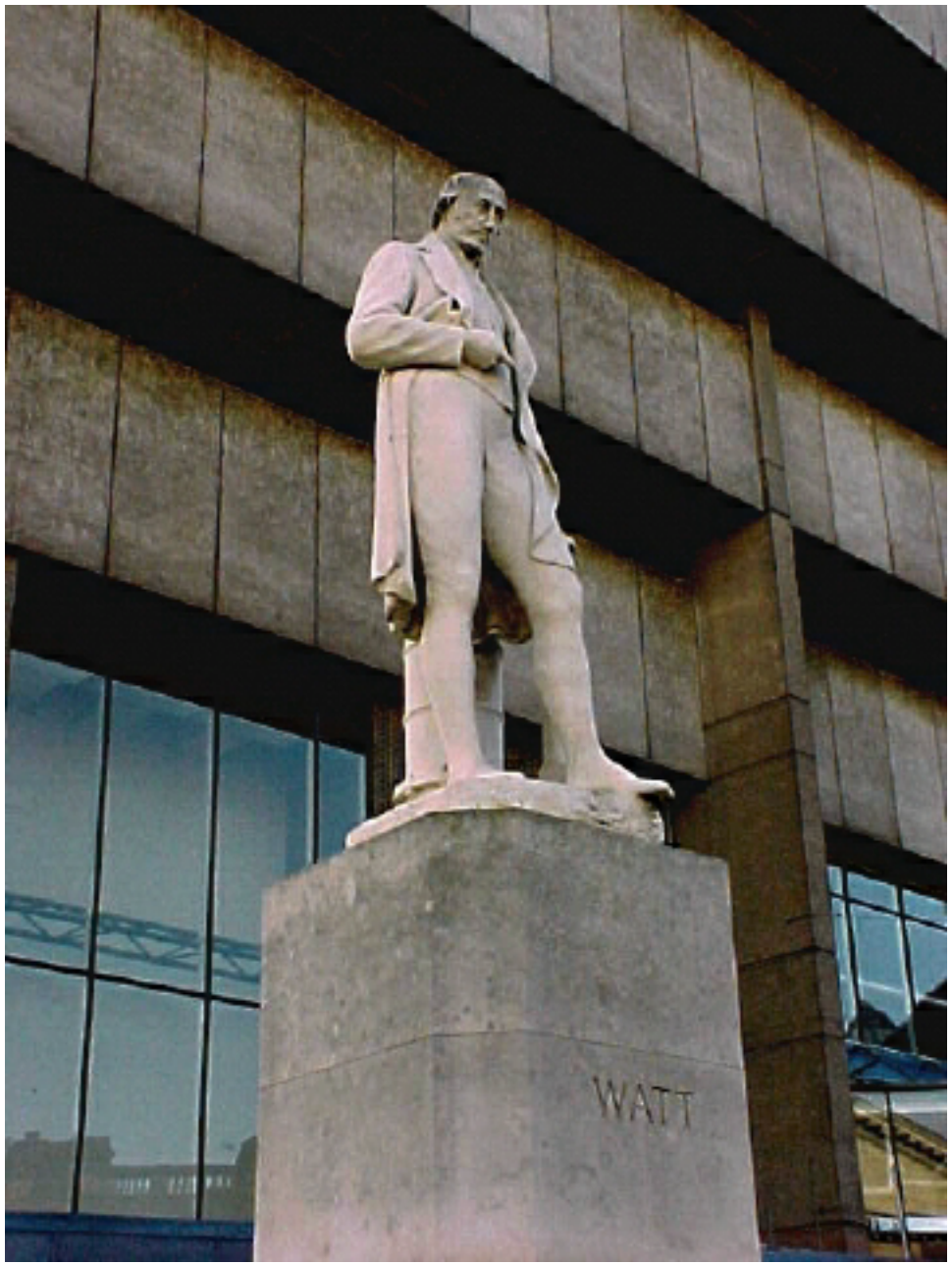
Energy per area per time

Power per area

Unit:

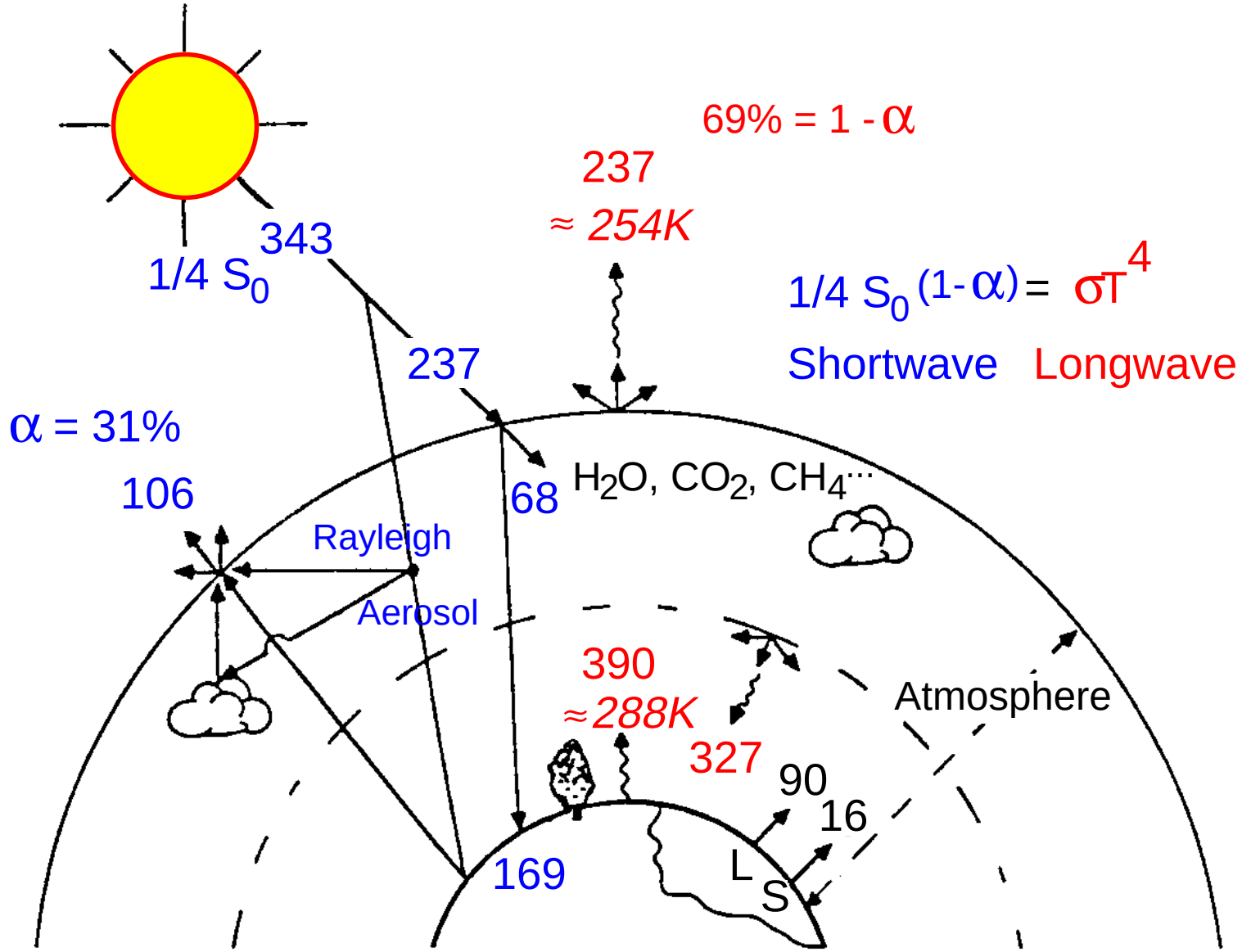
Watt per square meter

$W\ m^{-2}$



GLOBAL ENERGY BALANCE

Global and annual average energy fluxes in watts per square meter

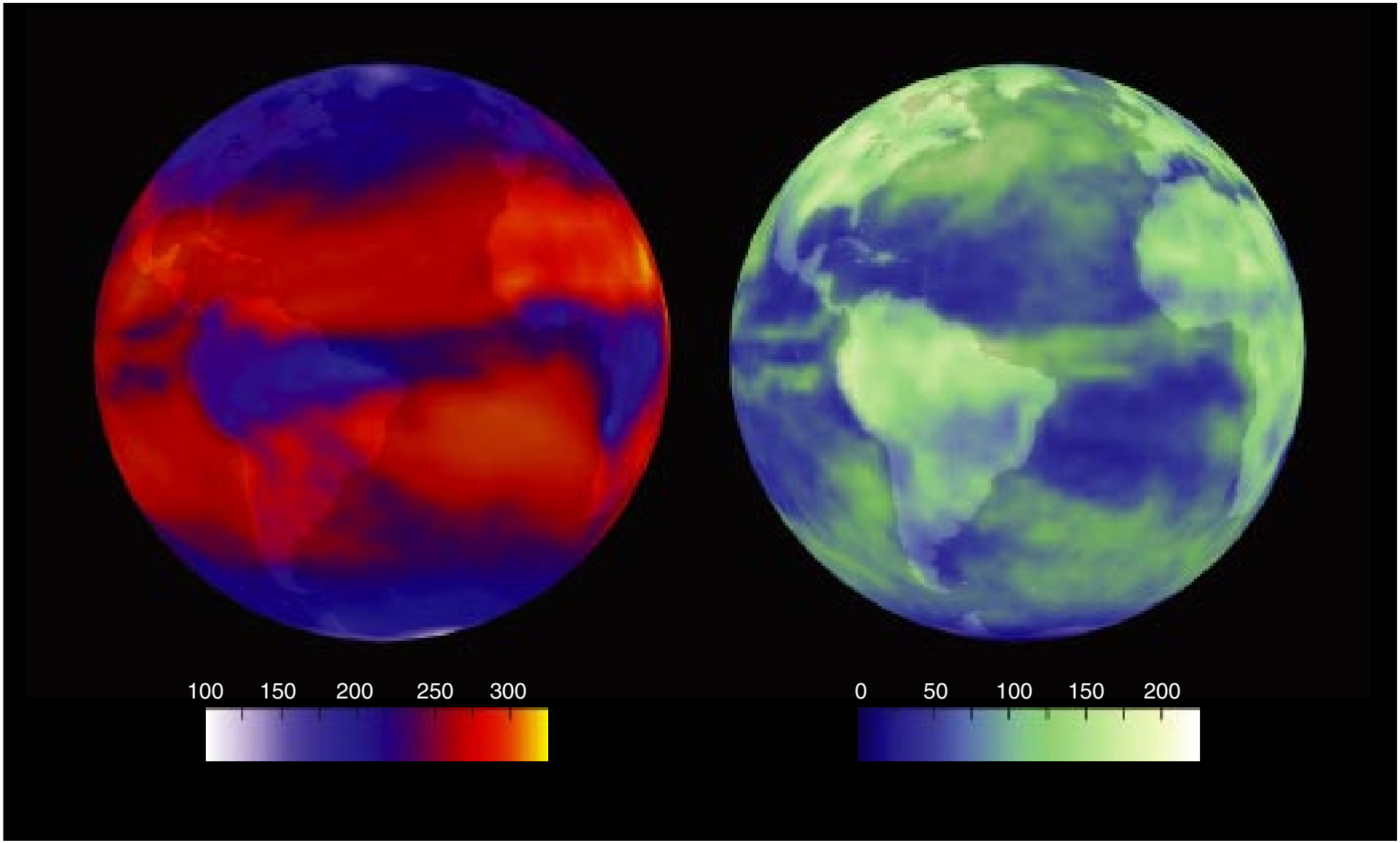


Schwartz, 1996, modified from Ramanathan, 1987

GEOGRAPHICAL VARIATION OF ATMOSPHERIC RADIATION

Annual average radiative flux at top of atmosphere, W m^{-2}

Emitted thermal infrared Reflected shortwave



CERES (Clouds and Earth's Radiant Energy System satellite, March, 2000 - May, 2001

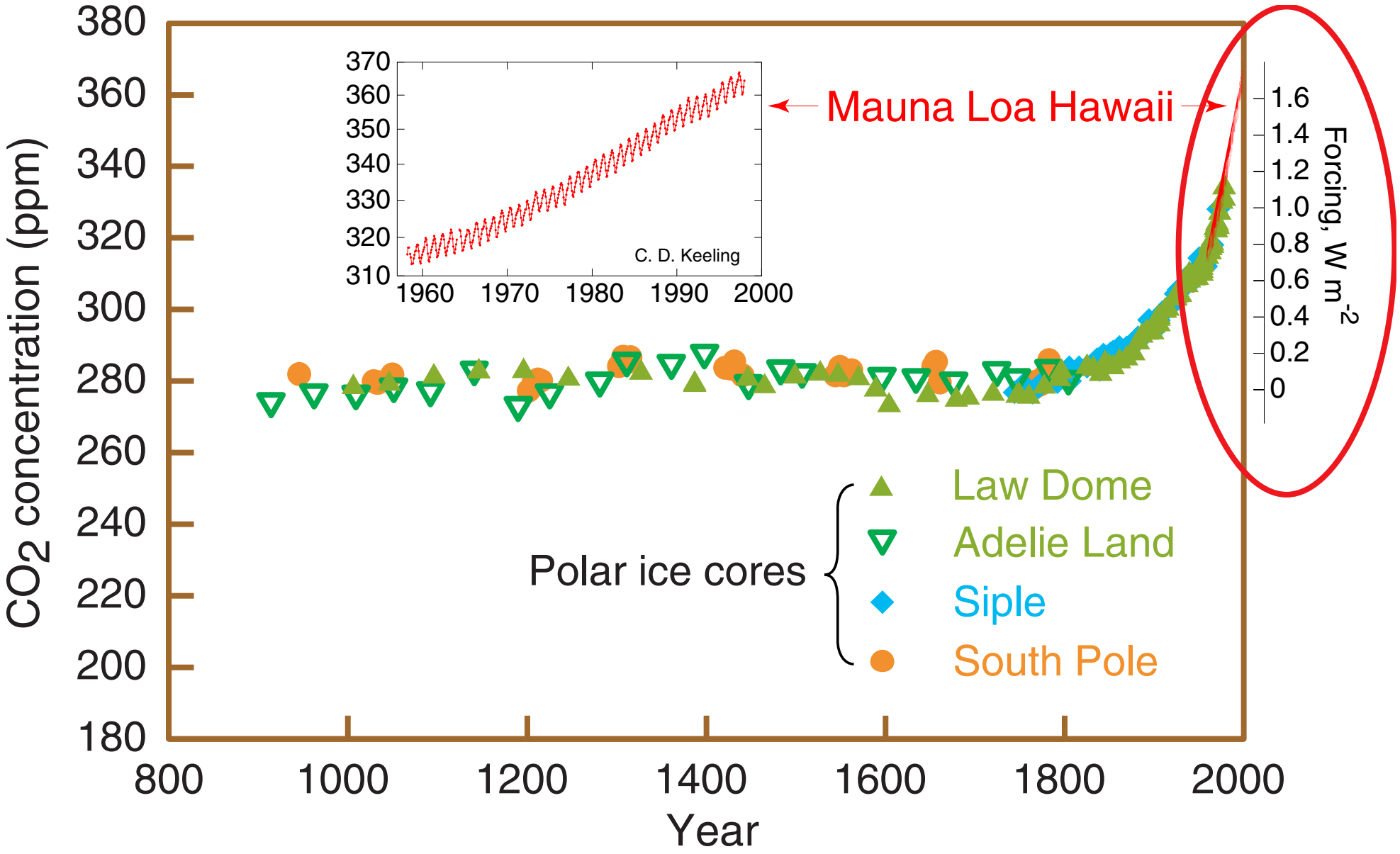
Everybody talks about the weather —

But nobody does anything about it.

– Mark Twain

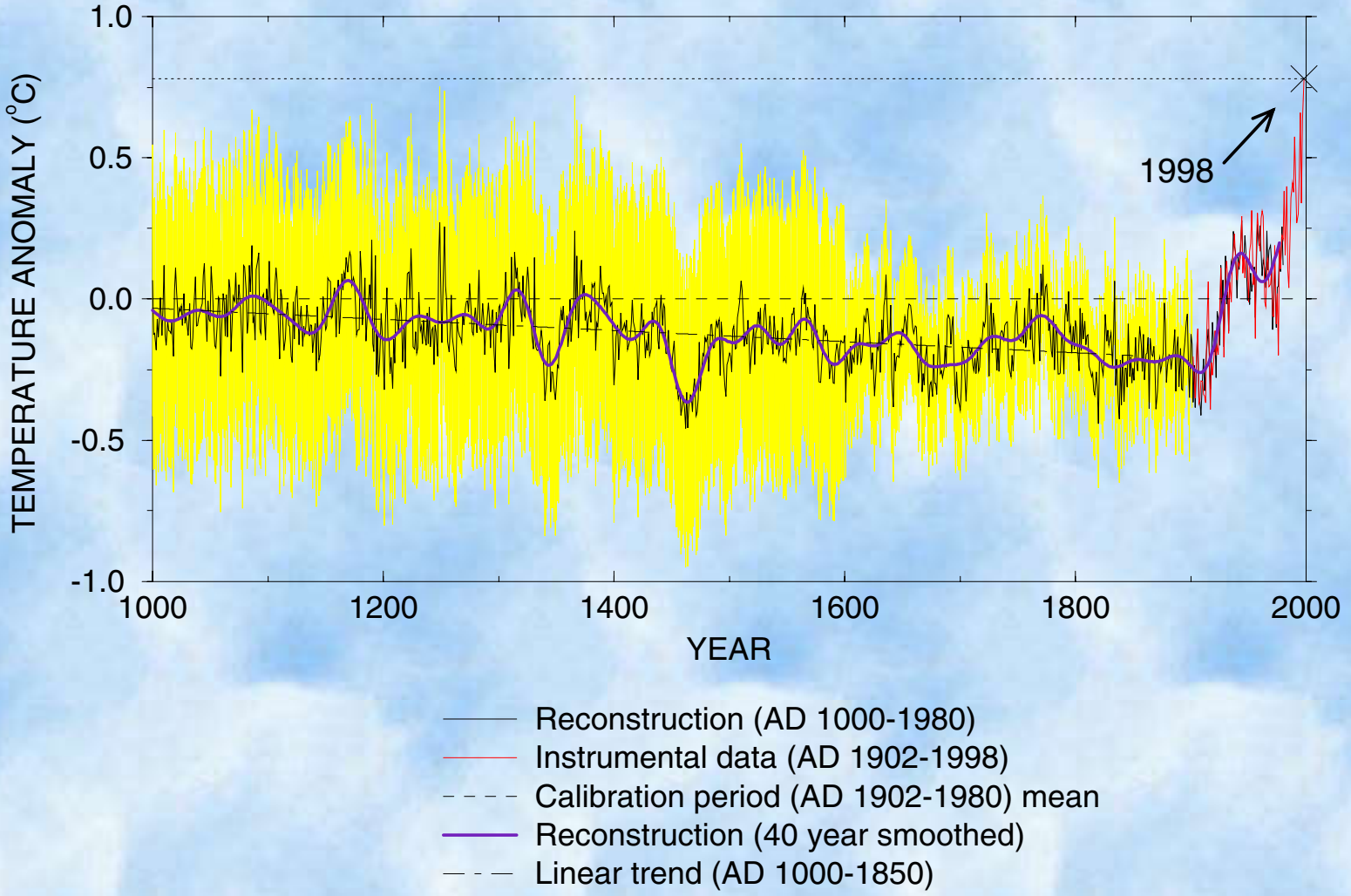
Now with the greenhouse effect,
we ARE doing something about it.
What are we doing?

ATMOSPHERIC CARBON DIOXIDE IS INCREASING



Global carbon dioxide concentration and infrared radiative forcing over the last thousand years

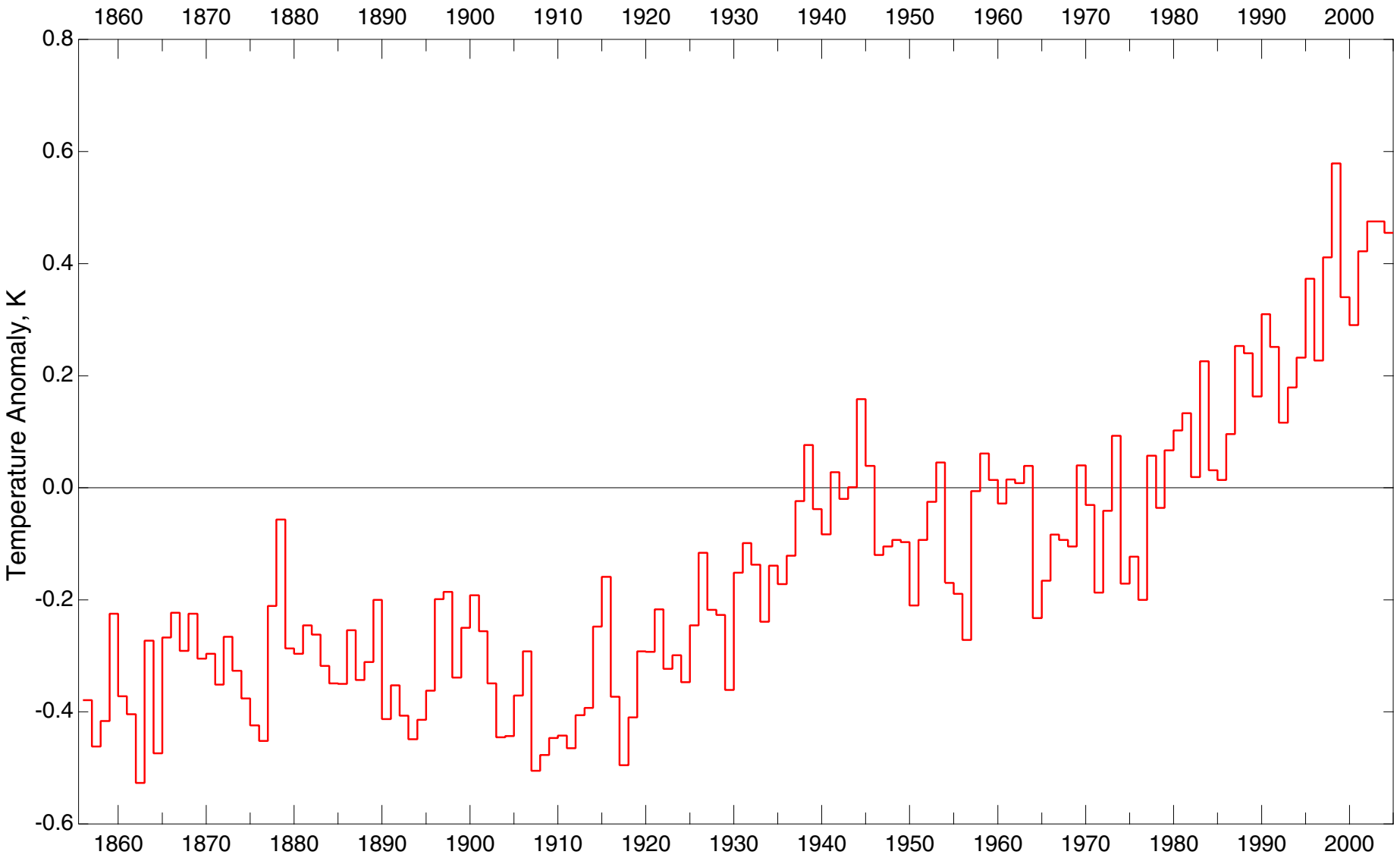
THE TEMPERATURE'S RISING



Northern Hemisphere temperature trend (1000-1998), from tree-ring, coral, and ice-core proxy records As calibrated by instrumental measurements.

Mann et al., Geophysical Research Letters, 1999

CHANGE IN GLOBAL MEAN SURFACE TEMPERATURE 1855-2004



Climate Research Unit, University of East Anglia, UK

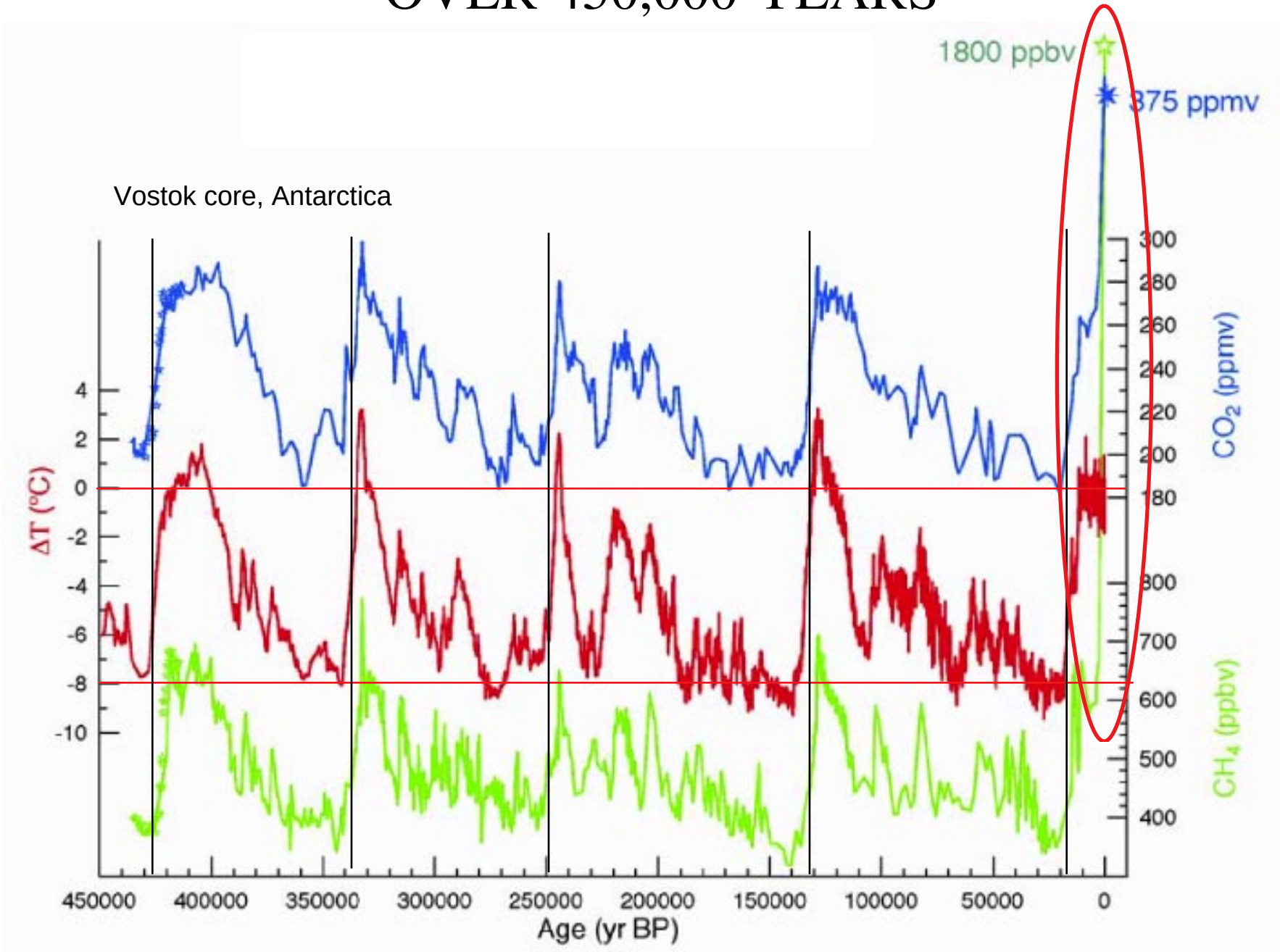
INDICATIONS OF SYSTEMATIC WARMING IN RECENT YEARS

The 1990s were the ***warmest decade*** in the instrumental record.

The ***warmest two years*** of the entire instrumental record have been 1998 and 2002.

The ***nine warmest years*** globally have now occurred in the 1990s and 2000s.

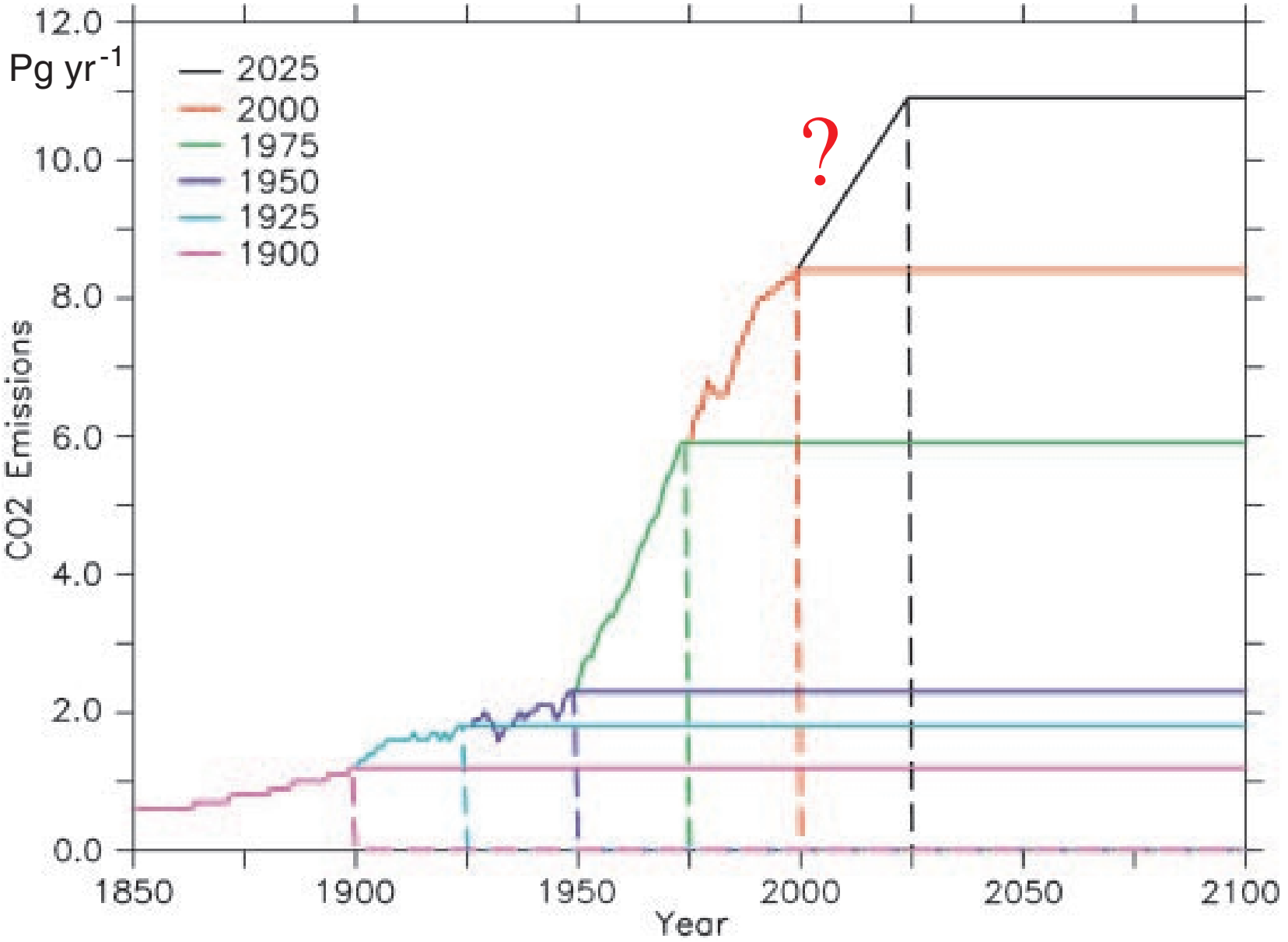
GREENHOUSE GASES AND TEMPERATURE OVER 450,000 YEARS



Modified from Petit et al., Nature, 1999

CARBON DIOXIDE EMISSIONS

Past and Future

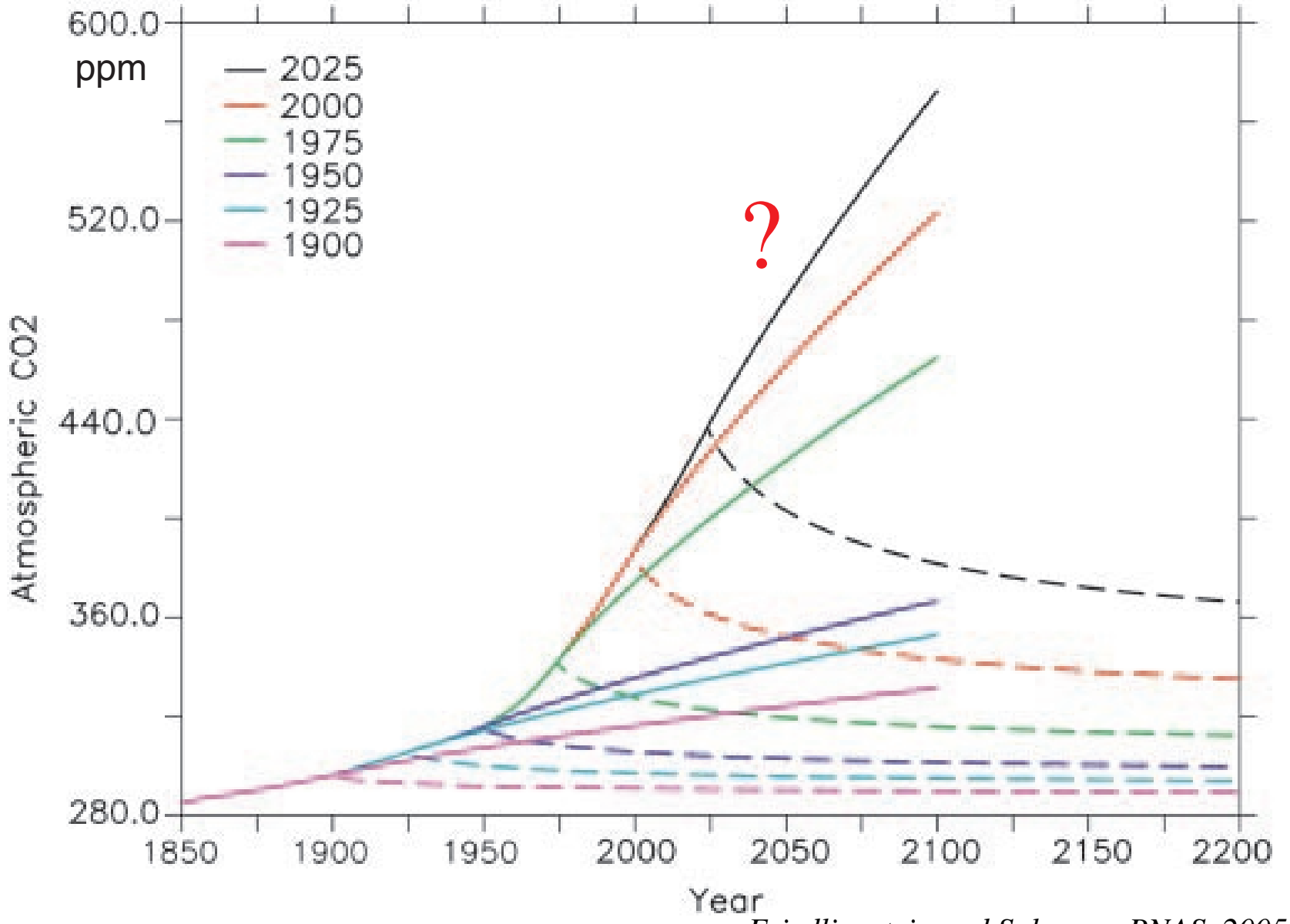


Friedlingstein and Solomon, PNAS, 2005

DEFORESTATION AS A SOURCE OF ATMOSPHERIC CO_2

CARBON DIOXIDE IN THE ATMOSPHERE

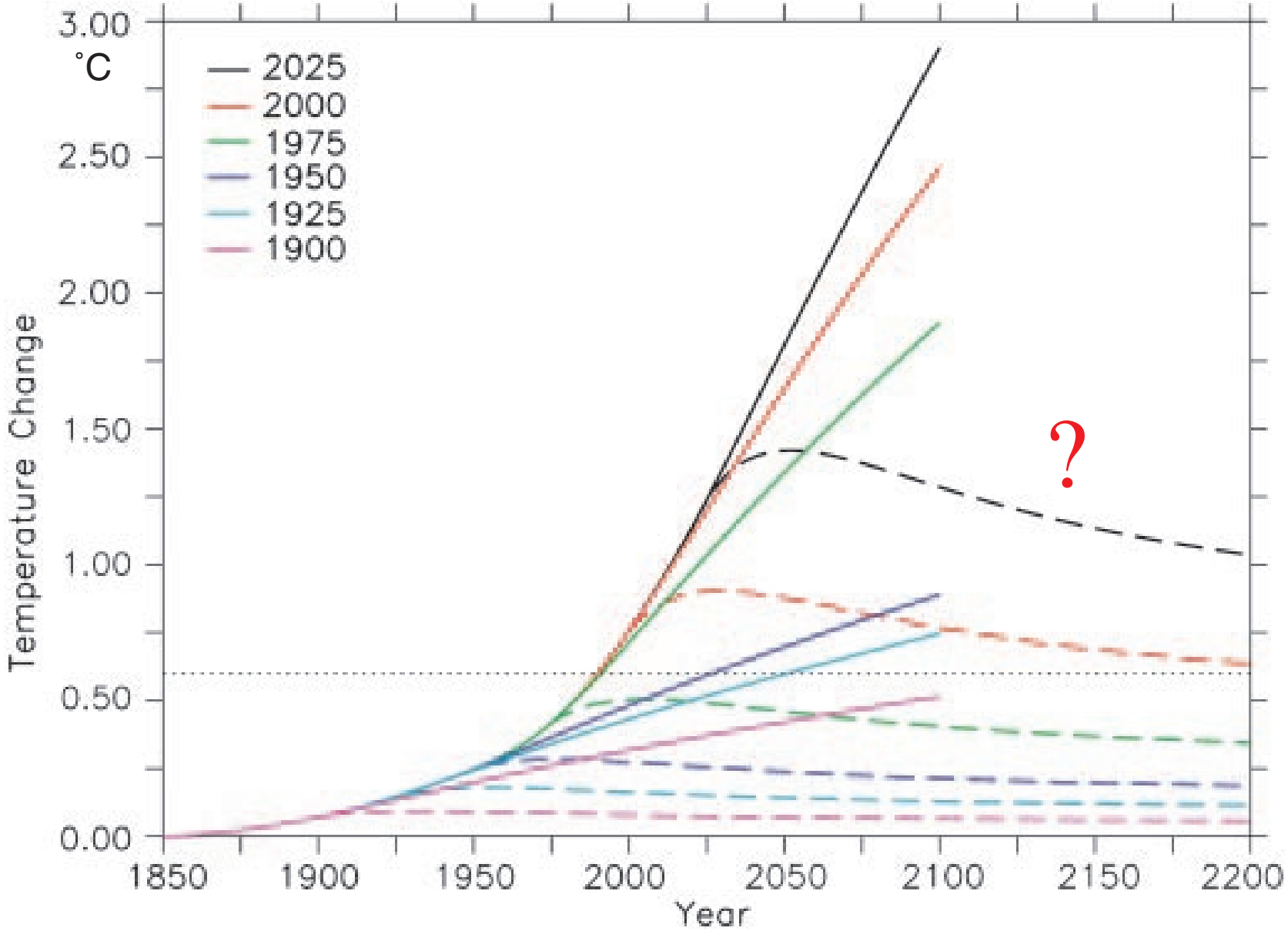
Past and Future



Friedlingstein and Solomon, PNAS, 2005

GLOBAL MEAN SURFACE TEMPERATURE CHANGE

Past and Future

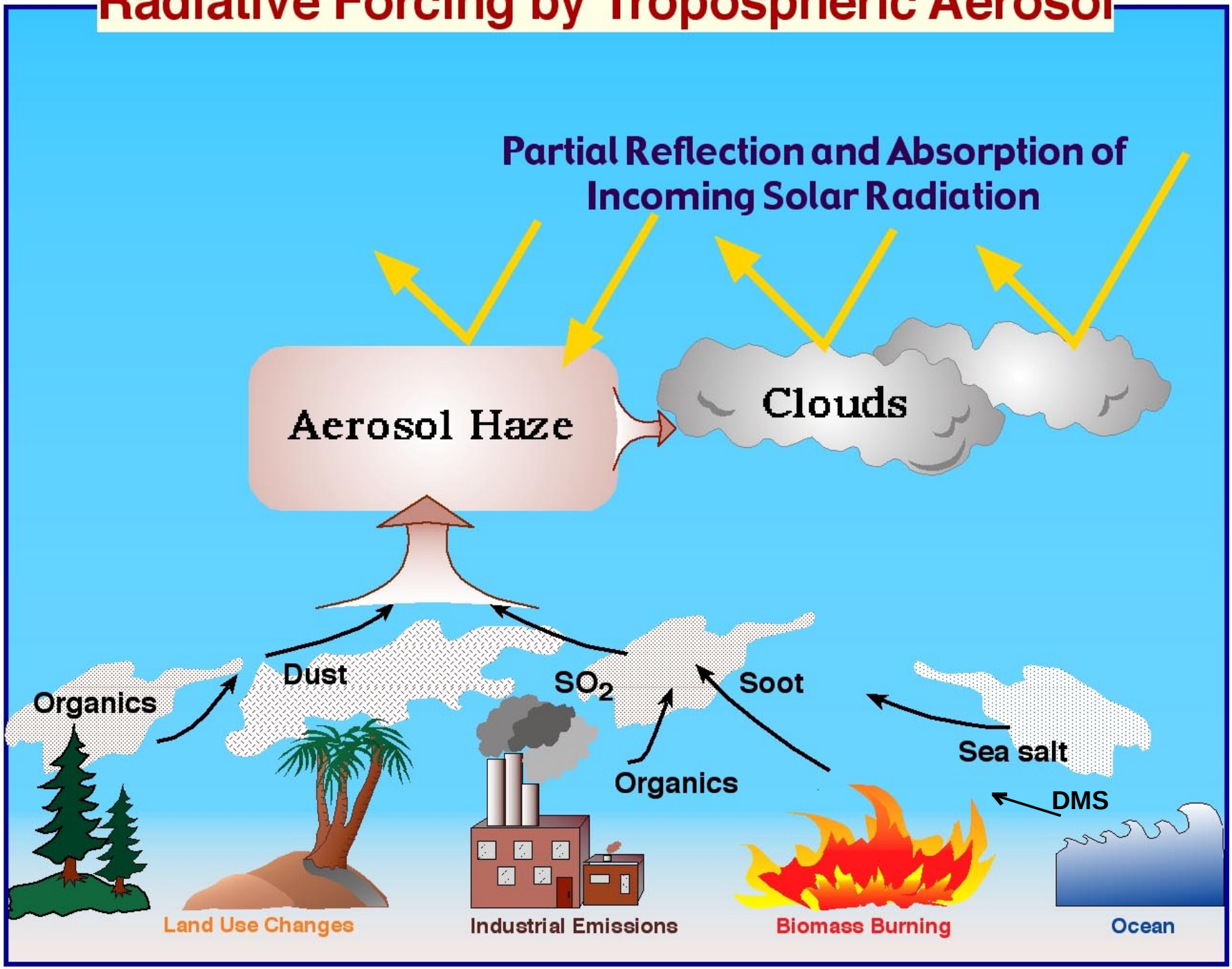


Friedlingstein and Solomon, PNAS, 2005

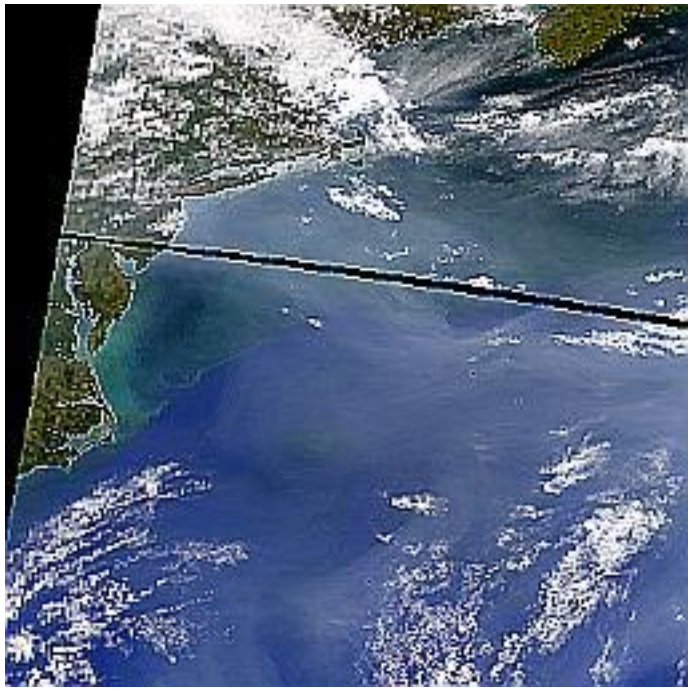
WHAT'S MISSING FROM THIS STORY?

RADIATIVE FORCING BY AEROSOLS

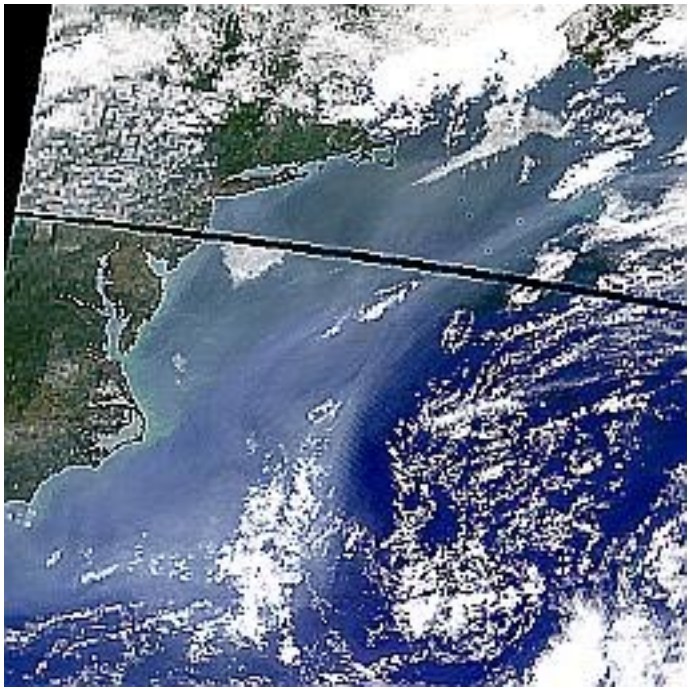
Radiative Forcing by Tropospheric Aerosol



LIGHT SCATTERING BY ANTHROPOGENIC AEROSOLS, 2000

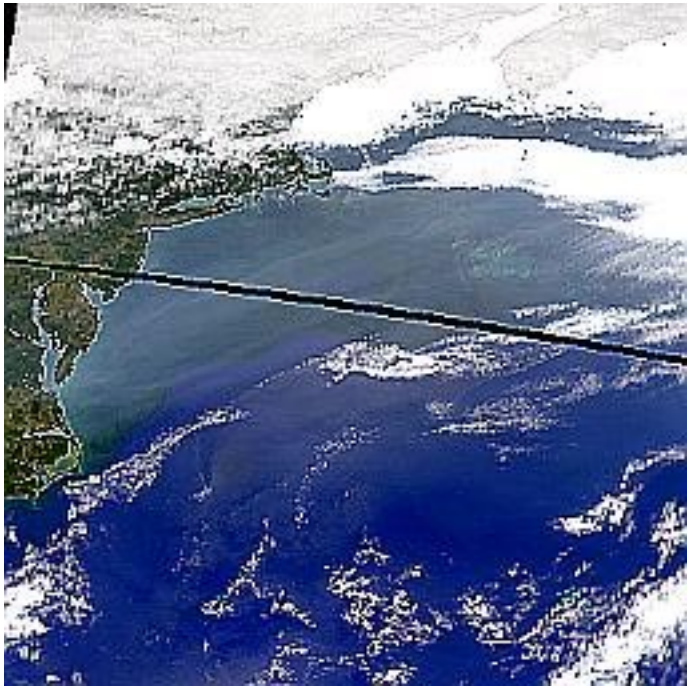


May 8



June 2

June 3



June 11

SEAWIFS images

IMPLICATIONS OF AEROSOL FORCING

- Aerosol negative (cooling) forcing is likely ***offsetting*** a substantial fraction of positive (warming) forcing by greenhouse gases.
- A substantial fraction of the forcing of 40 years of CO_2 emissions is being offset by ***a week's worth of aerosol***.
- The aerosol forcing is likely responsible for the ***low apparent climate sensitivity*** based on greenhouse gas forcing only.
- It is very likely that the global warming due to CO_2 and other GHG's is ***substantially greater*** than has been experienced thus far.

WHERE IS ALL THIS CO_2 COMING FROM?

WHO IS RESPONSIBLE?

HOW MUCH CARBON IS IN A GALLON OF GASOLINE?

1 lb?

2 lbs?

3 lbs!?

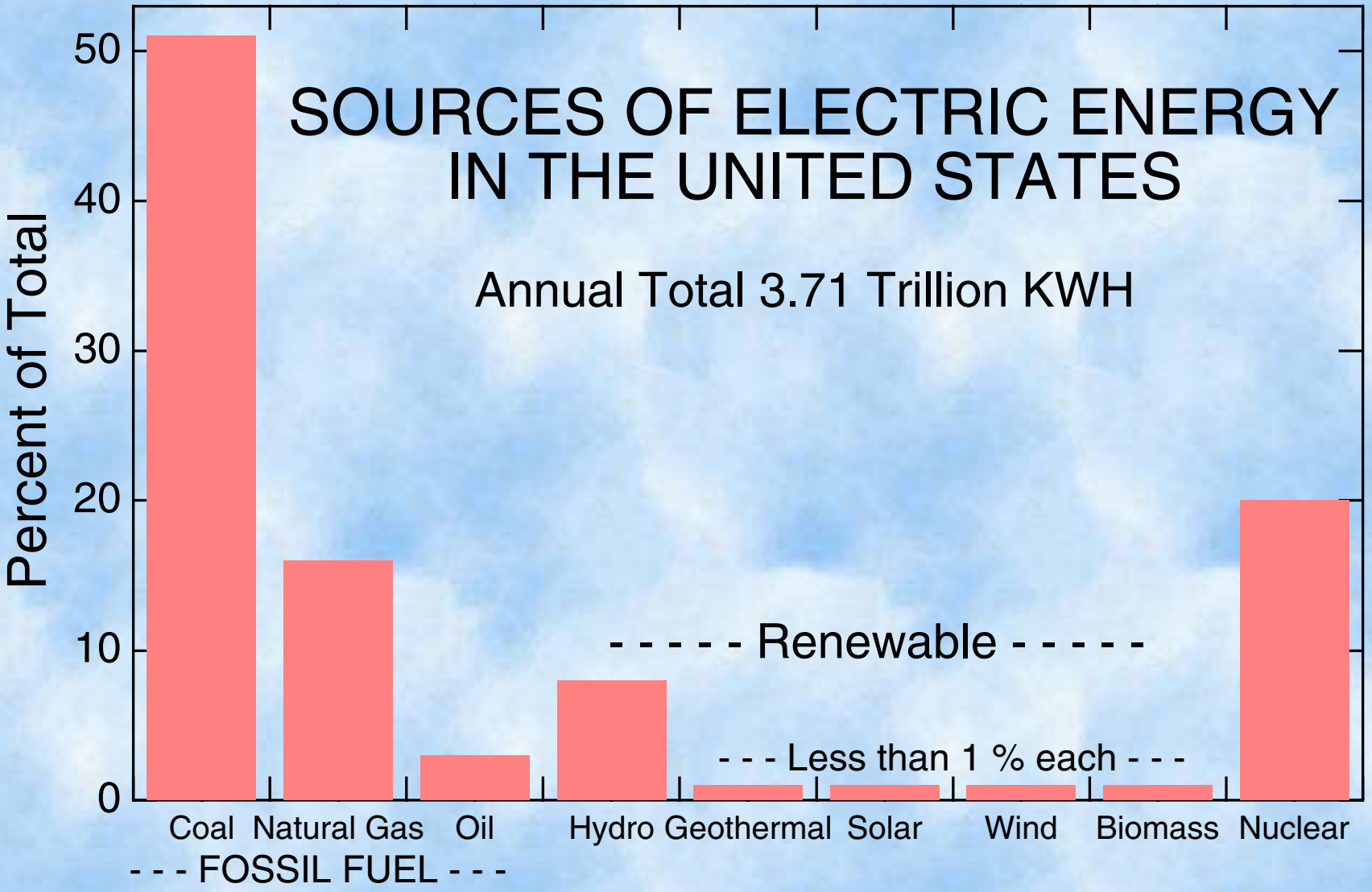
5 lbs!?!

All of this carbon goes into the atmosphere as carbon dioxide when you burn the gasoline in your car.

THE MOST EFFECTIVE WAY TO DOUBLE THE FUEL ECONOMY OF A CAR . . .

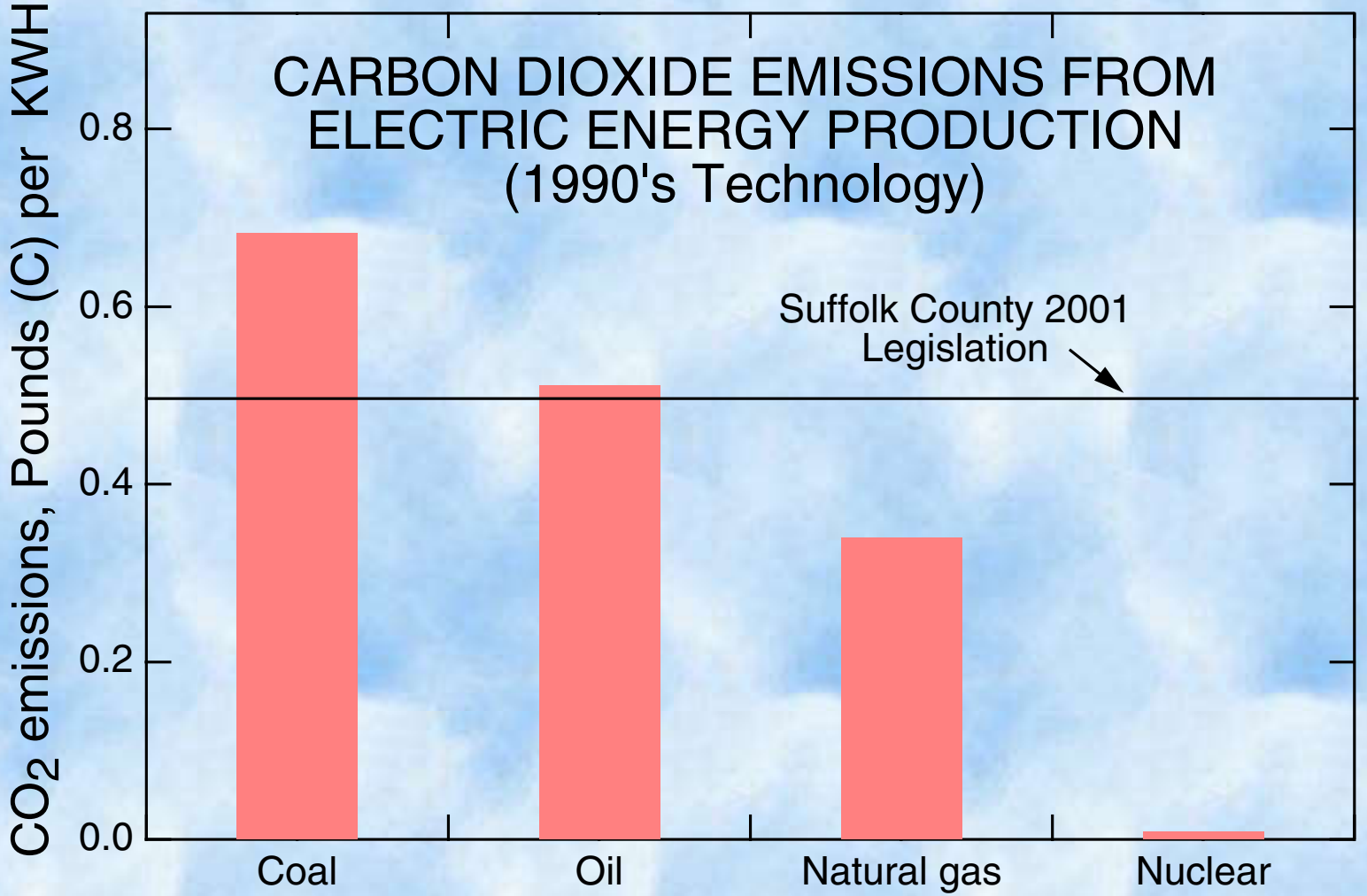
IS TO PUT TWO PEOPLE IN IT!

WHERE DOES YOUR ELECTRIC ENERGY COME FROM?



On Long Island most electric energy derives from combustion of oil.

YOUR FAMILY'S CONTRIBUTION TO THE GREENHOUSE EFFECT



A typical household using 1000 kilowatt hours of electricity per month is responsible for emission of 3 tons of carbon a year in the form of carbon dioxide.

How much does your household contribute?

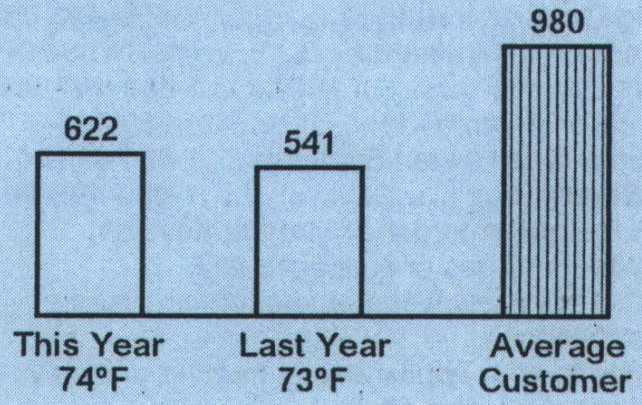
YOUR CONTRIBUTION TO THE GREENHOUSE EFFECT

ELECTRIC SUPPLY AND DELIVERY FROM LIPA

Meter Readings Meter # 15790134

	Jul 24	93155 Actual
	Jun 26	92533 Actual
Use	28 **Days**	622 **KWH**

Comparisons KWH



Cost Rate 880 - Water and Home Heating

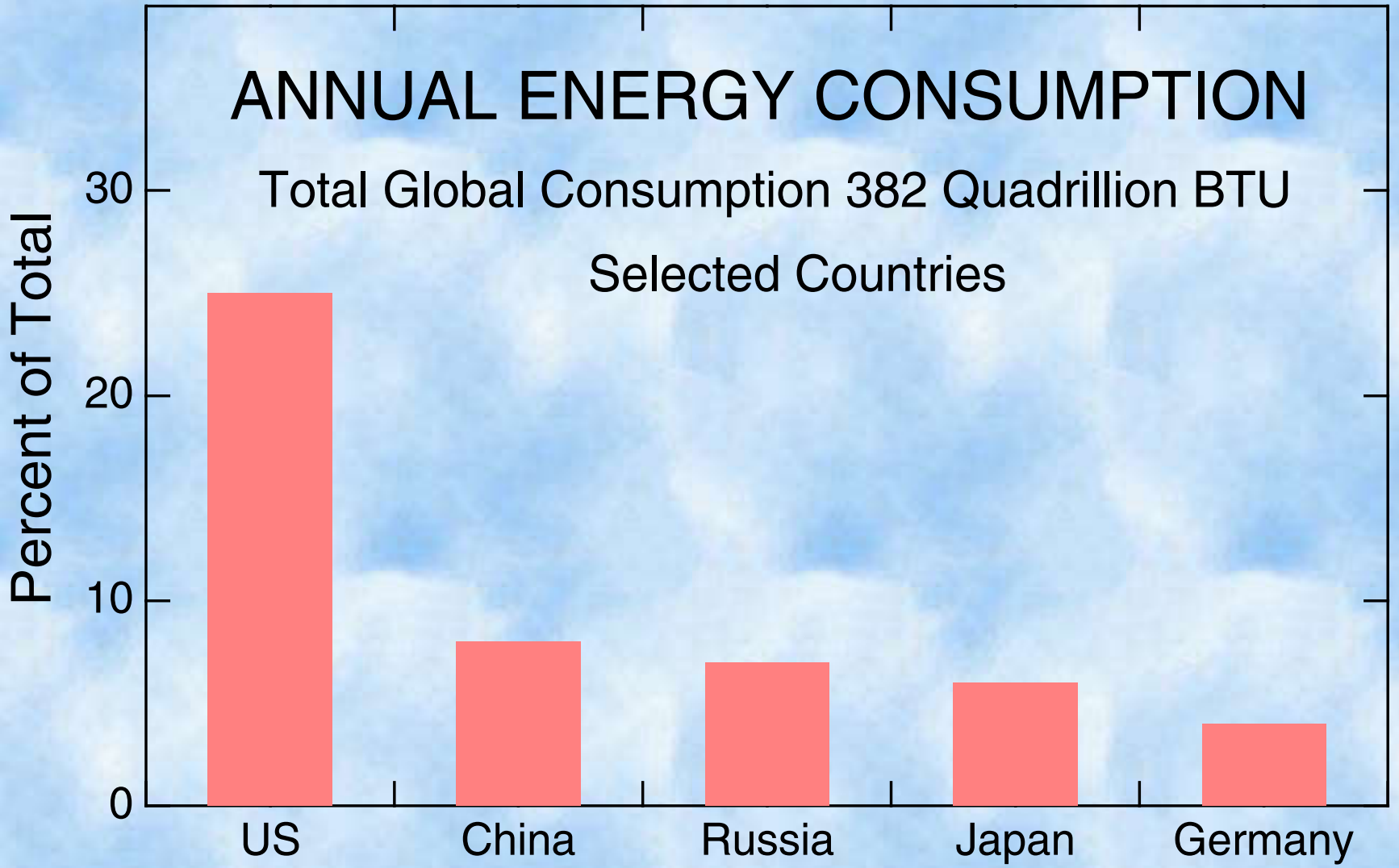
Basic Service: 28 Days @ 17.90¢	$5.01
Use: 233 KWH @ 12.49¢	29.10
140 KWH @ 13.67¢	19.14
249 KWH @ 9.78¢	24.35
Excess Fuel Price Surcharge	4.28
PILOTs and Credits	1.40
Shoreham Credit	-.59
Sales Tax: @ 1%	.83
Total	$83.52

LIPA
Long Island Power Authority

Jul 25, 2001	927 20 1805 3 5	1-800-490-0025	See Back Of Bill
Date	Account Number	Any Questions?	Service Problems

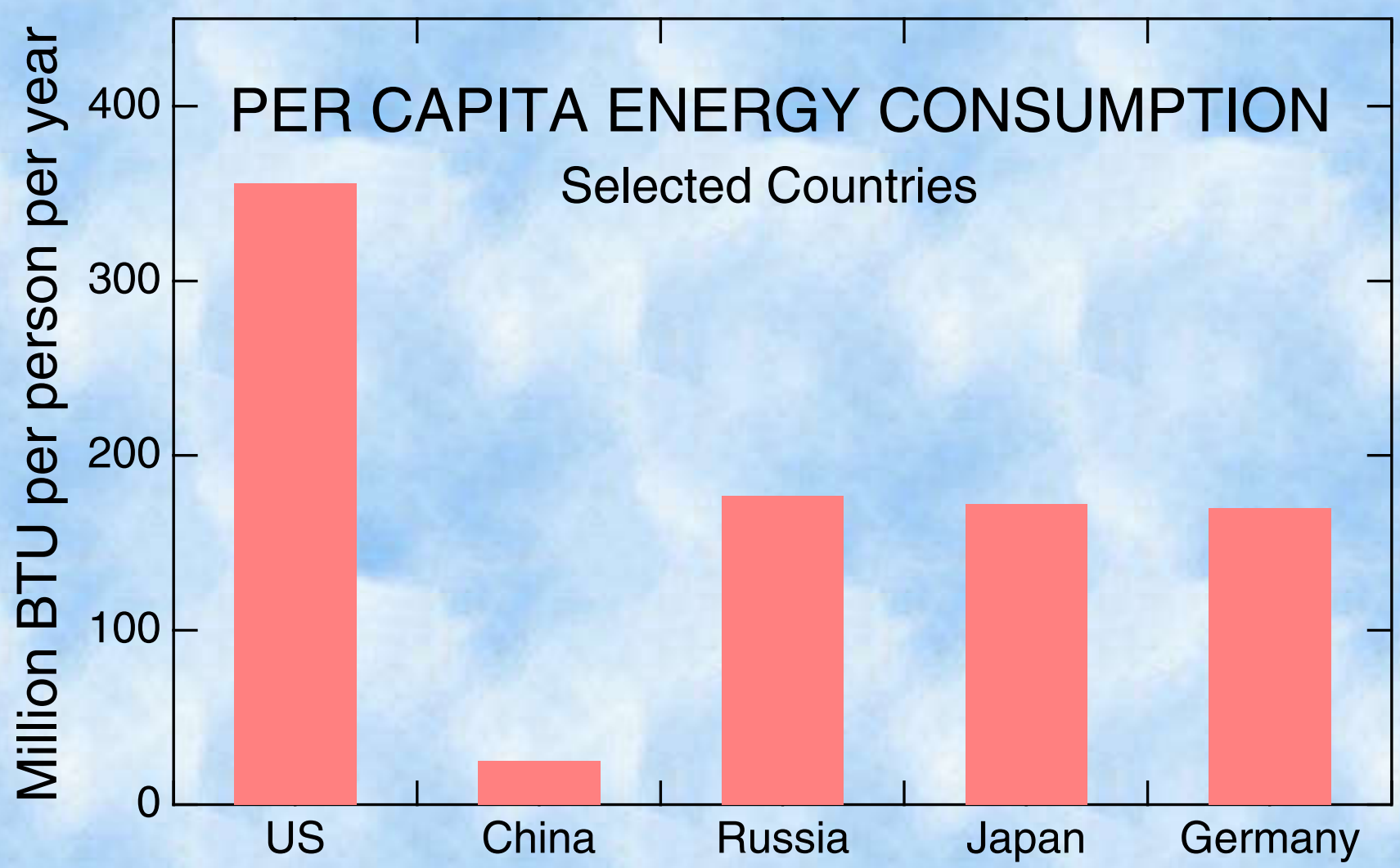
At half a pound of carbon per KWH, the average household is responsible for emission of 500 pounds of carbon a month .

WHAT COUNTRY USES THE MOST ELECTRIC POWER?



No surprise. It's the United States.

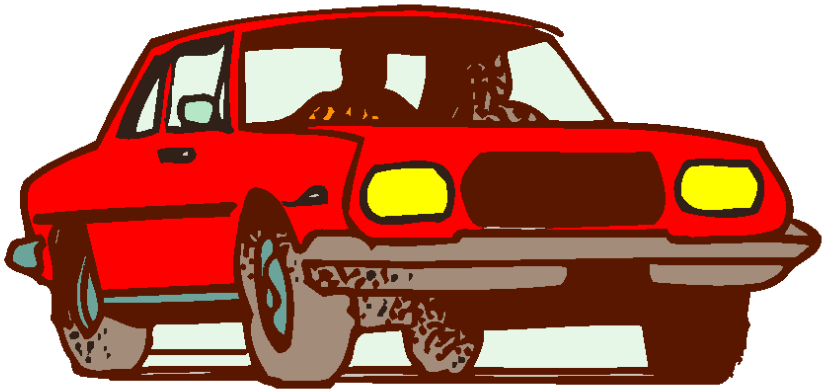
WHAT COUNTRY USES THE MOST ELECTRIC POWER ***PER CAPITA***?



No surprise. It's the United States again.

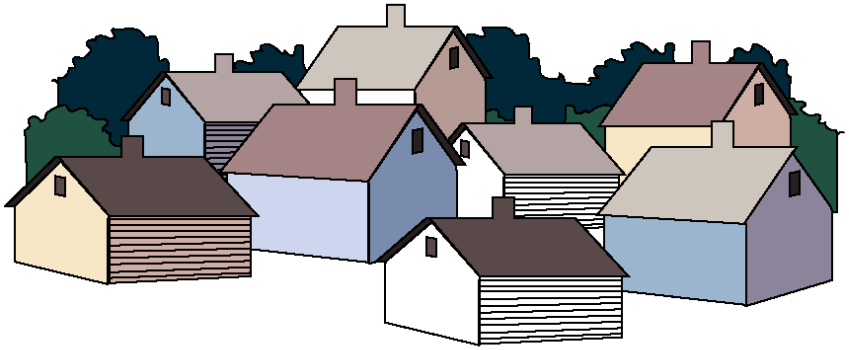
WHERE IS THIS CARBON DIOXIDE COMING FROM?

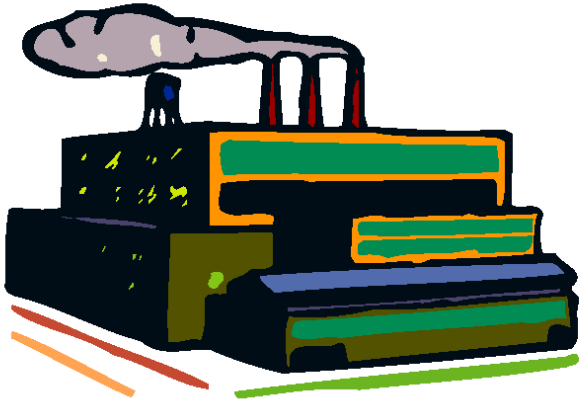
WE ARE ALL RESPONSIBLE.



Burning a gallon of gasoline in your car puts 5 pounds of carbon in the atmosphere as carbon dioxide (CO_2), and it will stay there for decades — maybe a century!

Other sources are home heating and electric power production.





Global Atmosphere, Global Warming

QUESTIONS ABOUT GLOBAL WARMING

- IS IT REAL?
- IS IT IMPORTANT?
- WHAT IS IT DUE TO?
- HOW MUCH MORE CAN WE EXPECT?
- ARE WE SEEING JUST THE TIP OF THE ICEBERG?

RESEARCH AT BROOKHAVEN NATIONAL LABORATORY IS HELPING TO ANSWER THESE QUESTIONS.